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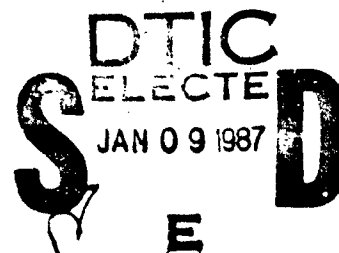
HISTORIC PROPERTIES REPORT

ROCKY MOUNTAIN ARSENAL

COMMERCE CITY, COLORADO

FINAL REPORT

AUGUST 1984



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This document was prepared by the MacDonald and Mack Partnership, Minneapolis, Minnesota, under Contract CX-0001-2-0033 between Building Technology Incorporated, Silver Spring, Maryland, and the Historic American Buildings Survey/Historic American Engineering Record, National Park Service, U.S. Department of the Interior.

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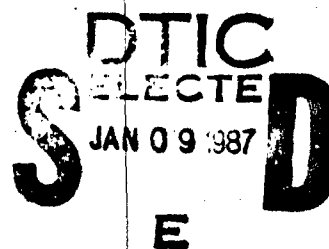
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EXECUTIVE SUMMARY

Rocky Mountain Arsenal (RMA) is part of the Army's Armament, Munitions and Chemical Command (AMCCOM). The arsenal is a government-owned-and-operated installation occupying 17,238 acres in Commerce City, Colorado, just north of Denver. Constructed in 1942 to manufacture war gases, RMA was soon expanded for the production of incendiary munitions. After V-J Day, the installation was designated a standby facility, and much of its chemical plant was leased to private industry — an arrangement that continues to the present day. Although RMA was reactivated for incendiary production during the Korean and Vietnam wars, its principal activities since 1950 have been the manufacture, munitions-loading, and disposal of nerve agent GB. These operations have centered in a GB production-and-filling complex constructed in 1953 and partially converted into a detoxification center in the 1970s. At present, the nerve-agent manufacturing and filling lines are in standby status; the detoxification center is in active use.

RMA comprises 299 buildings, about half of which date from the 1940s. The installation also contains three farmhouses (Buildings T-131, T-373, T-831) and a garage (T-831-A) that were acquired with the site. Constructed sometime between 1910 and 1930, these structures contribute to a general understanding of the area's pre-military history, but they are not of specific architectural or historical significance. Because the arsenal's original production lines have been removed and many of its original buildings remodeled, the installation no longer retains the architectural

and technological character of a World War II installation. There are no Category I, Category II, or Category III historic properties at RMA.

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PREFACE

This report presents the results of an historic properties survey of the Rocky Mountain Arsenal (RMA). Prepared for the United States Army Materiel Development and Readiness Command (DARCOM), the report is intended to assist the Army in bringing this installation into compliance with the National Historic Preservation Act of 1966 and its amendments, and related federal laws and regulations. To this end, the report focuses on the identification, evaluation, documentation, nomination, and preservation of historic properties at the RMA. Chapter 1 sets forth the survey's scope and methodology; Chapter 2 presents an architectural, historical, and technological overview of the installation and its properties; and Chapter 3 identifies significant properties by Army category and sets forth preservation recommendations. Illustrations and an annotated bibliography supplement the text.

This report is part of a program initiated through a memorandum of agreement between the National Park Service, Department of the Interior, and the U.S. Department of the Army. The program covers 74 DARCOM installations and has two components: 1) a survey of historic properties (districts, buildings, structures, and objects), and 2) the development of archaeological overviews. Stanley H. Fried, Chief, Real Estate Branch of Headquarters DARCOM, directed the program for the Army, and Dr. Robert J. Kapech, Chief of the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) directed the program for the National Park Service. Sally Kress Tompkins was program manager, and Robie S. Lange was

project manager for the historic properties survey. Technical assistance was provided by Donald C. Jackson.

Building Technology Incorporated acted as primary contractor to HABS/HAER for the historic properties survey. William A. Brenner was BTI's principal-in-charge and Dr. Larry D. Lankton was the chief technical consultant. Major subcontractors were the MacDonald and Mack Partnership and Jeffrey A. Hess. The author of this report was Jeffrey A. Hess. The author would like to thank the many employees at RMA who graciously assisted him in his research and field surveys. He especially acknowledges the help of Tom Donnelly, Public Affairs Officer; Dr. William McNeill, Director of Technical Operations; Jim L. Green, Facilities Engineer; and Darlene Puleo, Management Assistant.

The complete HABS/HAER documentation for this installation will be included in the HABS/HAER collections at the Library of Congress, Prints and Photographs Division, under the designation HAER No. CO-21.

Chapter 1
INTRODUCTION

SCOPE

This report is based on an historic properties survey conducted in September 1983 of all Army-owned properties located within the official boundaries of the Rocky Mountain Arsenal (RMA). The survey included the following tasks:

- . Completion of documentary research on the history of the installation and its properties.
- . Completion of a field inventory of all properties at the installation.
- . Preparation of a combined architectural, historical, and technological overview for the installation.
- . Evaluation of historic properties and development of recommendations for preservation of these properties.

Also completed as a part of the historic properties survey of the installation, but not included in this report, are HABS/HAER Inventory cards for 23 individual properties. These cards, which constitute HABS/HAER Documentation Level IV, will be provided to the Department of the Army. Archival copies of the cards, with their accompanying photographic

negatives, will be transmitted to the HABS/HAER collections at the Library of Congress.

The methodology used to complete these tasks is described in the following section of this report.

METHODOLOGY

1. Documentary Research

RMA was constructed in 1942 to manufacture toxic and incendiary munitions. Since the arsenal was one of four government-owned-and-operated installations involved in such activities during World War II, an evaluation of its historical significance requires a general understanding of the country's chemical-warfare manufacturing program. To identify relevant published sources, research on chemical munitions was conducted in standard bibliographies of military history, engineering, and the applied sciences. Unpublished sources were identified by researching the historical and technical archives of the U. S. Army Armament, Munitions and Chemical Command (AMCCOM) at Rock Island Arsenal.¹

In addition to such industry-wide research, a concerted effort was made to locate sources dealing specifically with the history and technology of RMA. This site-specific research was conducted primarily at the AMCCOM Historical Office at Rock Island Arsenal; the Denver Public Library in Denver, Colorado; and the government's

administrative and engineering archives at RMA. The Colorado State Historic Preservation Office (Colorado Heritage Center, Denver) was also contacted for information on the architecture, history, and technology of RMA, but had no pertinent data.

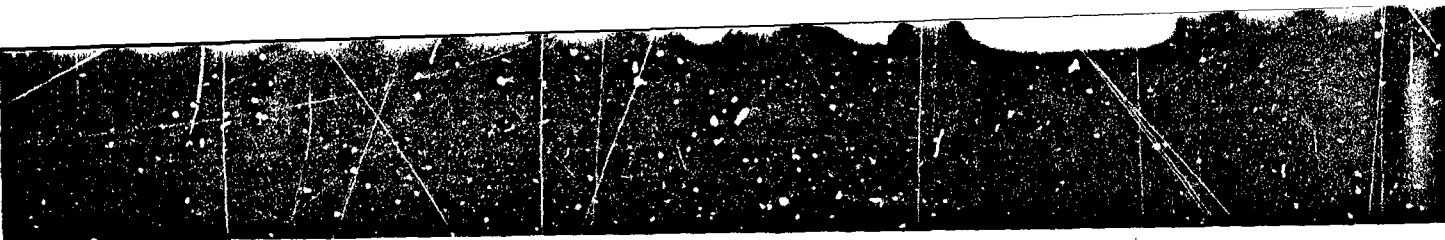
Army records used for the field inventory included current Real Property Inventory (RPI) printouts that listed all officially recorded buildings and structures by facility classification and date of construction; the installation's property record cards; base maps and photographs supplied by installation personnel; and installation master planning, archaeological, environmental assessment, and related reports and documents. A complete listing of this documentary material may be found in the bibliography.

2. Field Inventory

Architectural and technological field surveys were conducted in September 1983 by Jeffrey A. Hess. Following discussions with Tom Donnelly, Public Affairs Officer, and Jim L. Green, Facilities Engineer, the surveyor inspected major manufacturing and demilitarization facilities and completed a general field survey of all exterior areas at the installation. Tom Donnelly served as escort.

Field inventory procedures were based on the HABS/HAER Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures.² All areas and properties were visually surveyed.

Building locations and approximate dates of construction were noted



from the installation's property records and field-verified. Interior surveys were made of the major facilities to permit adequate evaluation of architectural features, building technology, and production equipment.

Field inventory forms were prepared for, and black and white 35 mm photographs taken of all buildings and structures through 1945 except basic utilitarian structures of no architectural, historical, or technological interest. When groups of similar ("prototypical") buildings were found, one field form was normally prepared to represent all buildings of that type. Field inventory forms were also completed for representative post-1945 buildings and structures.³ Information collected on the field forms was later evaluated, condensed, and transferred to HABS/HAER Inventory cards.

3. Historical Overview

A combined architectural, historical, and technological overview was prepared from information developed from the documentary research and the field inventory. It was written in two parts: 1) an introductory description of the installation, and 2) a history of the installation by periods of development, beginning with pre-military land uses. Maps and photographs were selected to supplement the text as appropriate.

The objectives of the overview were to 1) establish the periods of major construction at the installation. 2) identify important events

and individuals associated with specific historic properties, 3) describe patterns and locations of historic property types, and 4) analyze specific building and industrial technologies employed at the installation.

4. Property Evaluation and Preservation Measures

Based on information developed in the historical overviews, properties were first evaluated for historical significance in accordance with the eligibility criteria for nomination to the National Register of Historic Places. These criteria require that eligible properties possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that they meet one or more of the following:⁴

- A. Are associated with events that have made a significant contribution to the broad patterns of our history.
- B. Are associated with the lives of persons significant in the nation's past.
- C. Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.

- D. Have yielded, or may be likely to yield, information important in pre-history or history.

Properties thus evaluated were further assessed for placement in one of five Army historic property categories as described in Army Regulation 420-40:⁵

- Category I Properties of major importance
- Category II Properties of importance
- Category III Properties of minor importance
- Category IV Properties of little or no importance
- Category V Properties detrimental to the significance of adjacent historic properties.

Based on an extensive review of the architectural, historical, and technological resources identified on DARCOM installations nationwide, four criteria were developed to help determine the appropriate categorization level for each Army property. These criteria were used to assess the importance not only of properties of traditional historical interest, but also of the vast number of standardized or prototypical buildings, structures and production processes that were built and put into service during World War II, as well as of properties associated with many post-war technological achievements. The four criteria were often used in combination and are as follows:

- 1) Degree of importance as a work of architectural, engineering, or industrial design. This criterion took into account the

qualitative factors by which design is normally judged:
artistic merit, workmanship, appropriate use of materials,
and functionality.

- 2) Degree of rarity as a remaining example of a once widely used architectural, engineering, or industrial design or process.

This criterion was applied primarily to the many standardized or prototypical DARCOM buildings, structures, or industrial processes. The more widespread or influential the design or process, the greater the importance of the remaining examples of the design or process was considered to be. This criterion was also used for non-military structures such as farmhouses and other once prevalent building types.

- 3) Degree of integrity or completeness. This criterion compared the current condition, appearance, and function of a building, structure, architectural assemblage, or industrial process to its original or most historically important condition, appearance, and function. Those properties that were highly intact were generally considered of greater importance than those that were not.

- 4) Degree of association with an important person, program, or event. This criterion was used to examine the relationship of a property to a famous personage, wartime project, or similar factor that lent the property special importance.

The majority of DARCOM properties were built just prior to or during World War II, and special attention was given to their evaluation. Those that still remain do not often possess individual importance, but collectively they represent the remnants of a vast construction undertaking whose architectural, historical, and technological importance needed to be assessed before their numbers diminished further. This assessment centered on an extensive review of the military construction of the 1940-1945 period, and its contribution to the history of World War II and the post-war Army landscape.

Because technology has advanced so rapidly since the war, post-World War II properties were also given attention. These properties were evaluated in terms of the nation's more recent accomplishments in weaponry, rocketry, electronics, and related technological and scientific endeavors. Thus the traditional definition of "historic" as a property 50 or more years old was not germane in the assessment of either World War II or post-war DARCOM buildings and structures; rather, the historic importance of all properties was evaluated as completely as possible regardless of age.

Property designations by category are expected to be useful for approximately ten years, after which all categorizations should be reviewed and updated.

Following this categorization procedure, Category I, II, and III historic properties were analyzed in terms of:

- Current structural condition and state of repair. This information was taken from the field inventory forms and photographs, and was often supplemented by rechecking with facilities engineering personnel.
- The nature of possible future adverse impacts to the property. This information was gathered from the installation's master planning documents and rechecked with facilities engineering personnel.

Based on the above considerations, the general preservation recommendations presented in Chapter 3 for Category I, II, and III historic properties were developed. Special preservation recommendations were created for individual properties as circumstances required.

5. Report Review

Prior to being completed in final form, this report was subjected to an in-house review by Building Technology Incorporated. It was then sent in draft to the subject installation for comment and clearance and, with its associated historical materials, to HABS/HAER staff for technical review. When the installation cleared the report, additional draft copies were sent to DARCOM, the appropriate State Historic Preservation Officer, and, when requested, to the archaeological contractor performing parallel work at the

installation. The report was revised based on all comments collected, then published in final form.

NOTES

1. The following bibliographies of published sources were consulted: Industrial Arts Index, 1938-1957; Applied Science and Technology Index, 1958-1980; Engineering Index, 1938-1983; Robin Higham, ed., A Guide to the Sources of United States Military History (Hamden, Conn.: Archon Books, 1975); John E. Jeesup and Robert W. Coakley, A Guide to the Study and Use of Military History (Washington, D.C.: U.S. Government Printing Office, 1979); "Military Installations," Public Works History in the United States, eds., Suellen M. Hoy and Michael C. Robinson (Nashville: American Association for State and Local History, 1982), pp. 380-400. AMCCOM (formerly ARRCOM, or U.S. Army Materiel Readiness Command) is the military agency responsible for supervising the operation of government-owned munitions plants; its headquarters are located at Rock Island Arsenal, Rock Island, Illinois. Although there is no comprehensive index to AMCCOM archival holdings, the agency's microfiche collection of unpublished reports is itemized in ARRCOM, Catalog of Common Sources, Fiscal Year 1983, 2 vols. (no pl.: Historical Office, AMCCOM, Rock Island Arsenal, n.d.).
2. Historic American Buildings Survey/Historic American Engineering Record, National Park Service, Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures (unpublished draft, 1982).
3. Representative post-World War II buildings and structures were defined as properties that were: (a) "representative" by virtue of construction type, architectural type, function, or a combination of these, (b) of obvious Category I, II, or III historic importance, or (c) prominent on the installation by virtue of size, location, or other distinctive feature.
4. National Park Service, How to Complete National Register Forms (Washington, D.C.: U.S. Government Printing Office, January 1977).
5. Army Regulation 420-40, Historic Preservation (Headquarters, U.S. Army: Washington, D.C., 15 April 1984).

Chapter 2

HISTORICAL OVERVIEW

BACKGROUND

Rocky Mountain Arsenal (RMA) is a government-owned-and-operated installation occupying a 17,238-acre site in Commerce City, Colorado, just north of Denver. Constructed in 1942 to manufacture war gases, the arsenal was soon expanded for the production of incendiary munitions. After V-J Day, RMA was designated a standby facility, and much of its chemical plant was leased to private industry — an arrangement that continues to the present day. Although RMA was reactivated for incendiary production during the Korean and Vietnam wars, its principal activities since 1950 have been the manufacture, munitions-loading, and disposal of nerve agent GB. These operations have centered in a GB production-and-filling complex constructed in 1953 and partially converted into a detoxification center in the 1970s. Currently, RMA comprises 299 buildings, about half of which date from the World War II period. Because the arsenal's original production lines have been removed and many of its original buildings remodeled, the installation no longer retains the architectural and technological character of a World War II installation. The nerve-agent manufacturing and filling lines are in standby status; the detoxification center is in active use.

WORLD WAR II

In common parlance, the term "chemical warfare" is most closely associated with the use of toxic substances, especially poison gases. By military

definition, however, the term applies equally to the deployment of incendiary and smoke devices. During World War I, the United States produced all three types of chemical munitions at Edgewood Arsenal in Maryland, under the supervision of the newly created Chemical Warfare Service. Edgewood Arsenal remained the country's primary chemical-warfare installation until World War II, when Congress authorized the construction of three additional plants: Huntsville Arsenal in Huntsville, Alabama; Pine Bluff Arsenal in Pine Bluff, Arkansas; and RMA in Commerce City, Colorado.¹

Site Selection and Former Land Use

The selection of the RMA site was governed by the same basic criteria used in evaluating locations for all three of the new chemical-warfare arsenals. These considerations included:

- 1) a mid-continental location as a defense against enemy bombardment
- 2) proximity to main railroad lines
- 3) availability of an ample water supply and sufficient electrical power for processing purposes
- 4) availability of suitable labor²

Located in Commerce City, Colorado, only a few miles north of Denver, the RMA site satisfied all selection criteria. The City of Denver housed a sizeable industrial work force and was a major distribution center for rail freight and electrical power. The area's hydrology also assured an

abundance of well and river water for industrial purposes. When the federal government took possession of the 19,883-acre site in the spring of 1942, the installation contained about 700 farm buildings on a patchwork of cropland, pasture, and underbrush.³ Only three houses (Buildings T-131, T-373, T-831) and a garage (Building T-831-A) survive at the arsenal from this earlier period. Constructed sometime between 1910 and 1930, these structures are of modest size and unassuming design.

Construction

RMA was the last of the chemical-warfare plants to be built during World War II, and it profited from the experience of its predecessor installations. This was especially true in terms of the construction team. The same personnel that designed and built Huntsville Arsenal in Alabama repeated their roles for the RMA project: Colonel Carl H. Breitweiser of the Corps of Engineers as Area Engineer; Whitman, Requart and Smith of Baltimore as architect-engineer; and Kershaw, Swinerton and Walberg of San Francisco and Birmingham, Alabama, as prime contractor.⁴

All three World-War-II, chemical-warfare arsenals employed a similar utilitarian-industrial architecture that made extensive use of clay tile, transite, and wood framing. RMA, however, was unique in its overall design. At the other arsenals, manufacturing operations were scattered throughout the installations. At RMA, they were restricted to a 260-acre tract in the center of the plant, which resulted in a "[more] efficient and economic operation."⁵ This centralized area was originally designed for the production and bulk loading of two war gases lewisite

(dichlor-2-chloro-vinyl-arsine) and mustard (dichloroethyl sulfide).

Lewisite manufacturing took place in Buildings 511, 511A, 514, 514A, 515, and 516; mustard manufacturing in Buildings 412, 414, 422, 424, 425, 429, and 431. In addition to these facilities, the area also contained manufacturing plants for the following intermediate chemicals used in lewisite and/or mustard production: acetylene (Building 522), arsenic trichloride (Building 523), chlorine (Buildings 242, 243, 244, 247, 248, 249, 251, 254, 255), ethylene (Buildings 431, 433, 434, 435, 461, 462A, 463), sulfur monochloride (Building 411), and thionyl chloride (Buildings 471, 472, 473). To the east of the manufacturing area, there was a maintenance-and-storage area (600-series buildings), a cantonment area for Chemical Warfare Service personnel (Buildings 151-167), and a headquarters compound containing the post's Administration Building (Building 111) and Communications Building (Building 112). To the west of the manufacturing area, there was a small grouping of magazines (870-, 880-series buildings) (Figures 1-9).

Construction activities at RMA commenced in June 1942, and on January 1, 1943, the arsenal produced its first batch of mustard gas. The new year inaugurated a new construction program for a napalm bomb plant (Buildings 741-749), which was completed, just east of the manufacturing area, in the spring of 1943. Additional napalm-bomb manufacturing facilities (Buildings 731, 732) were authorized in the spring of 1945 and completed shortly after V-J Day (Figures 10, 11). At that time, the arsenal numbered approximately 280 buildings.⁶

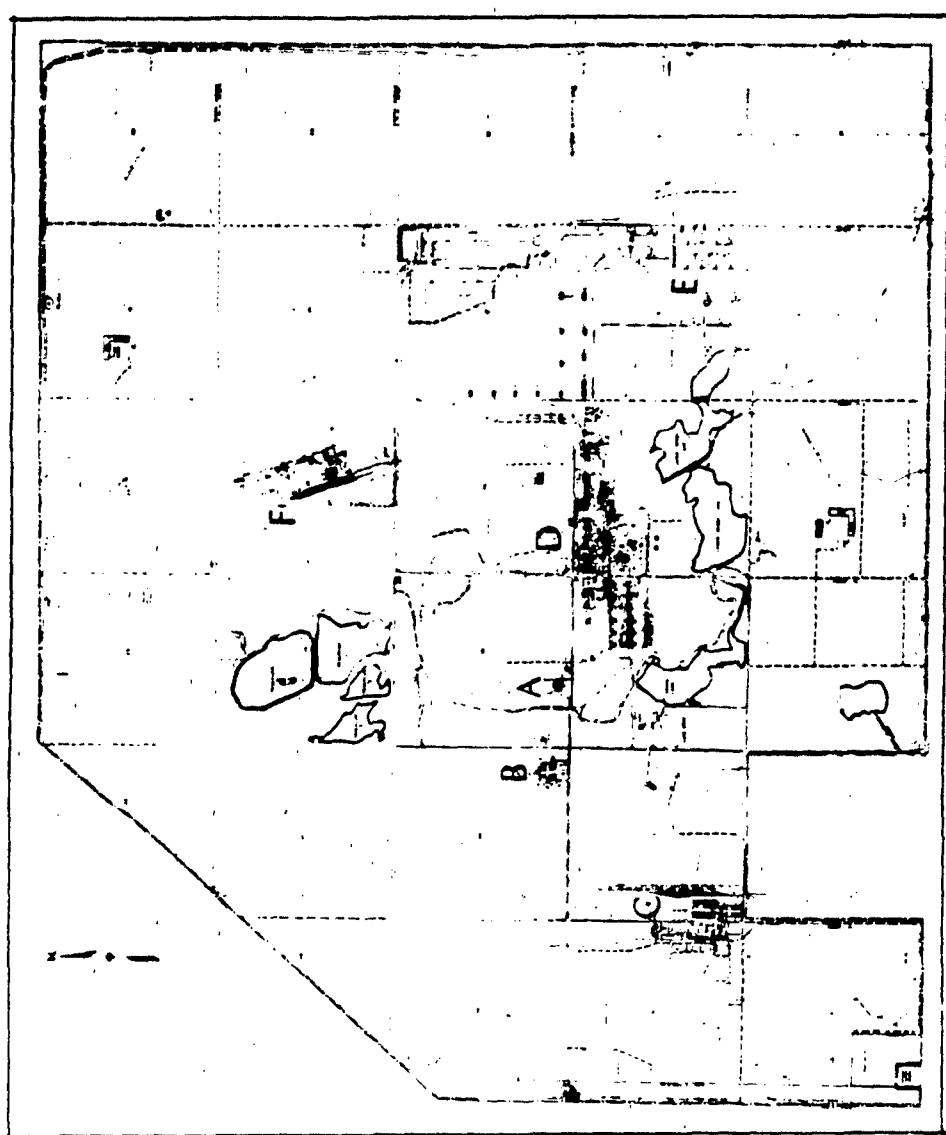


Figure 1: Installation site plan (Source: Facilities Engineer's Office Archives, RMA).

- A. Administration area.
- B. Cantonment area.
- C. Shop-and-storage area.
- D. Chemical-manufacturing area.
- E. Magazine area.
- F. Nerve-agent production and demilitarization area.

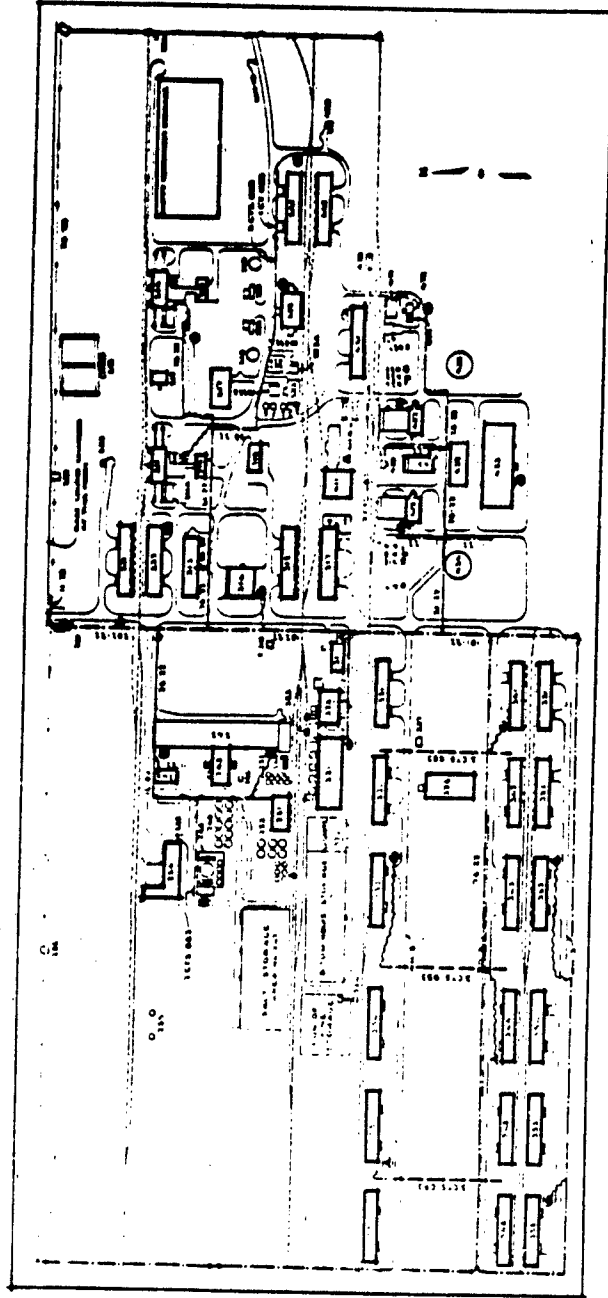


Figure 2: Chemical-manufacturing area (Source: Armed Service Forces, Chemical Warfare Service, "History of Rocky Mountain Arsenal," vol. 1, unpublished report, 1945, RMA Administrative Archives).



Figure 3: Aerial view of the chemical-manufacturing area, looking northeast, c. 1980 (Source: RMA Public Affairs Office).

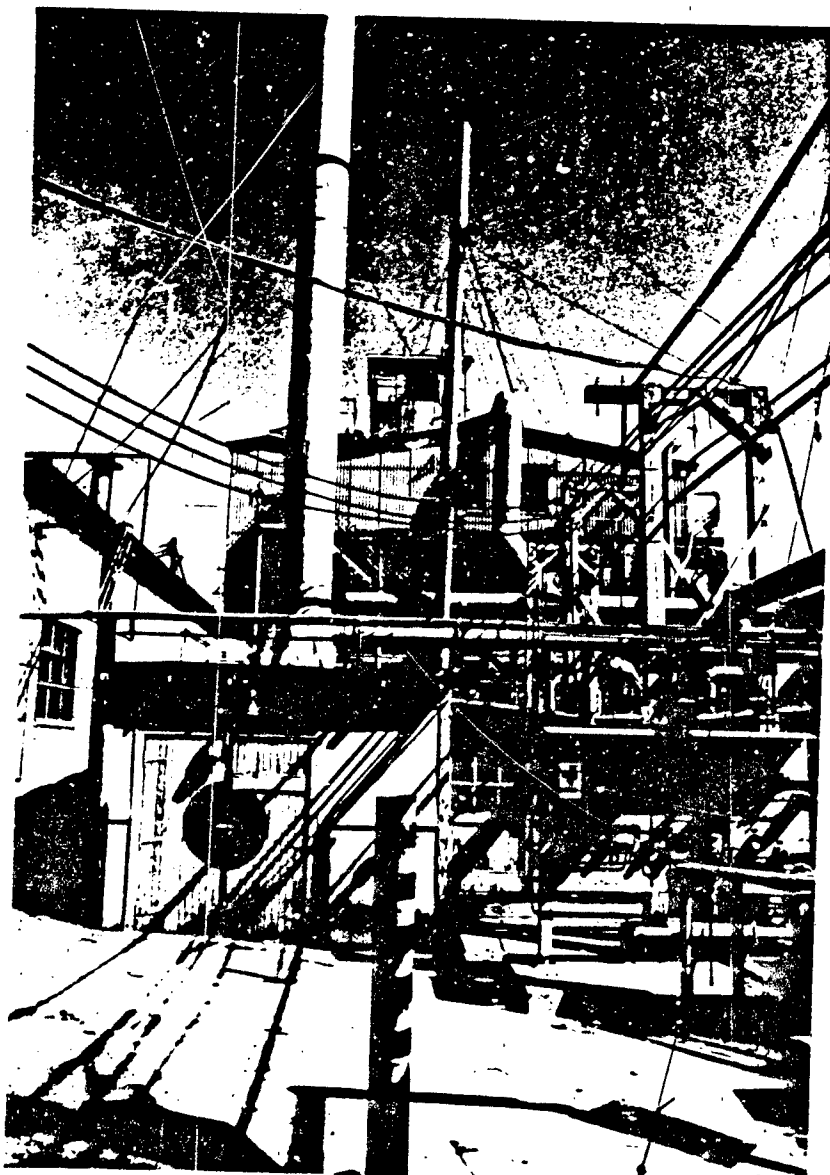


Figure 4: The former Lewisite Manufacturing Building (Building 514) is currently leased to Shell Oil Company (Source: Field inventory photograph, 1983, Jeffrey A. Hess, MacDonald and Mack Partnership).

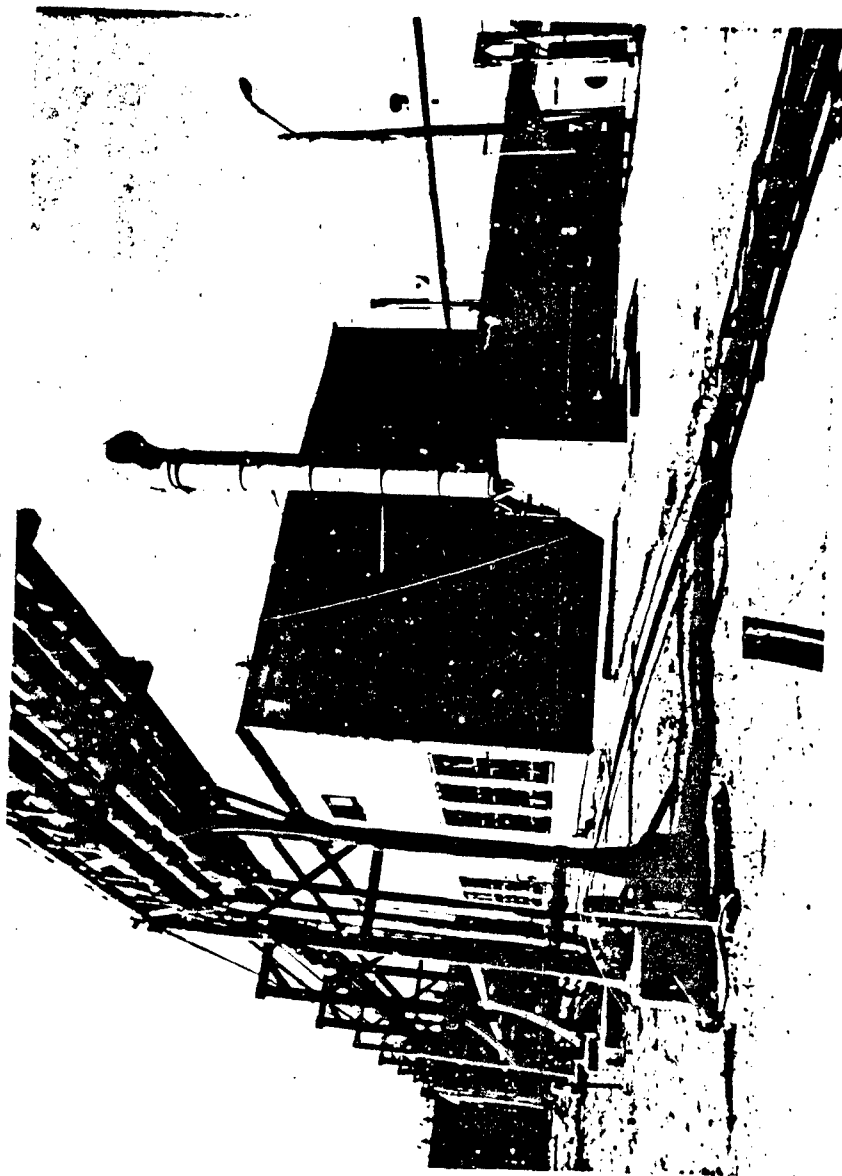


Figure 5: The former Mustard Gas Manufacturing Building (Building 422) is currently leased to Shell Oil Company (Source: Field inventory photograph, 1983, Jeffrey A. Hess, MacDonald and Mack Partnership).



Figure 6: The former Chlorine Manufacturing Building (Building 242) produced chlorine gas by the electrolysis of brine; it is now used as a warehouse (Source: "Rocky Mountain Arsenal Real Property Inventory," vol. 1, unpublished report prepared by Harland Bartholomew & Associates and Gilbert/Commonwealth Associates, Inc., 1982-1983).

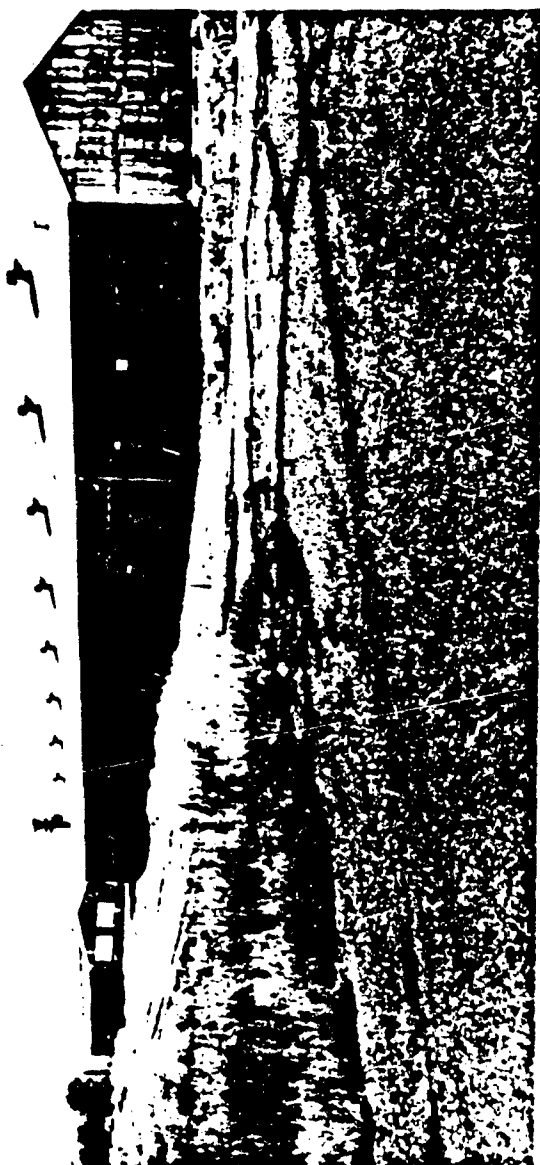


Figure 7: Building T-614 is typical of the warehouses in the arsenal's shop-and-storage area (Source: Field inventory photograph, 1983, Jeffrey A. Hess, MacDonald and Mack Partnership).

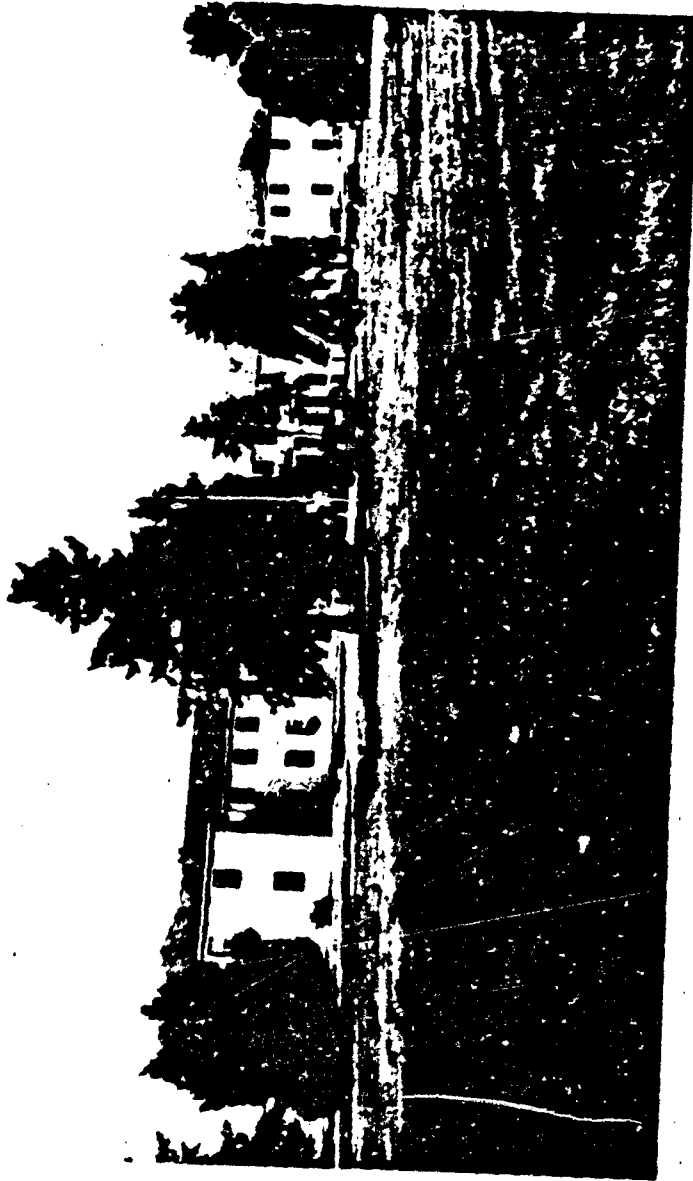


Figure 8: Administration Building (Building 111), looking north (Source: Field inventory photograph, 1983, Jeffrey A. Hess, MacDonald and Mack Partnership).

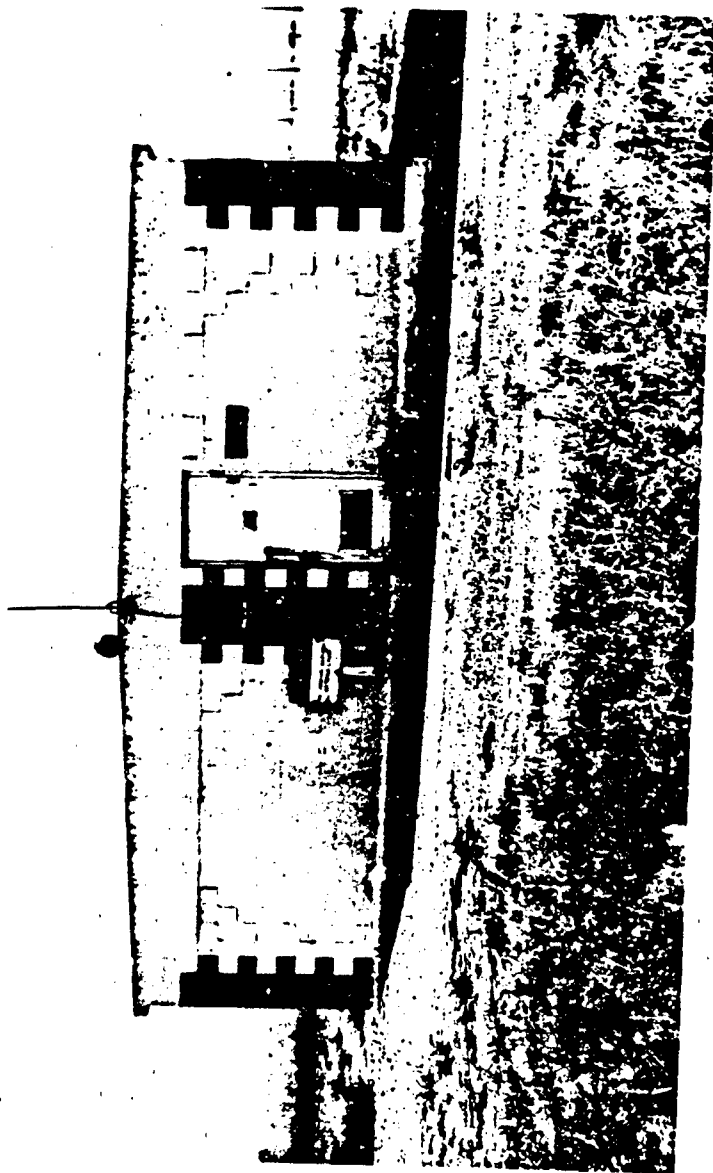


Figure 9: Building 871A is typical of the arsenal's above-ground storage magazines
(Source: Field inventory photograph, 1983, Jeffrey A. Hess, MacDonald
and Mack Partnership).



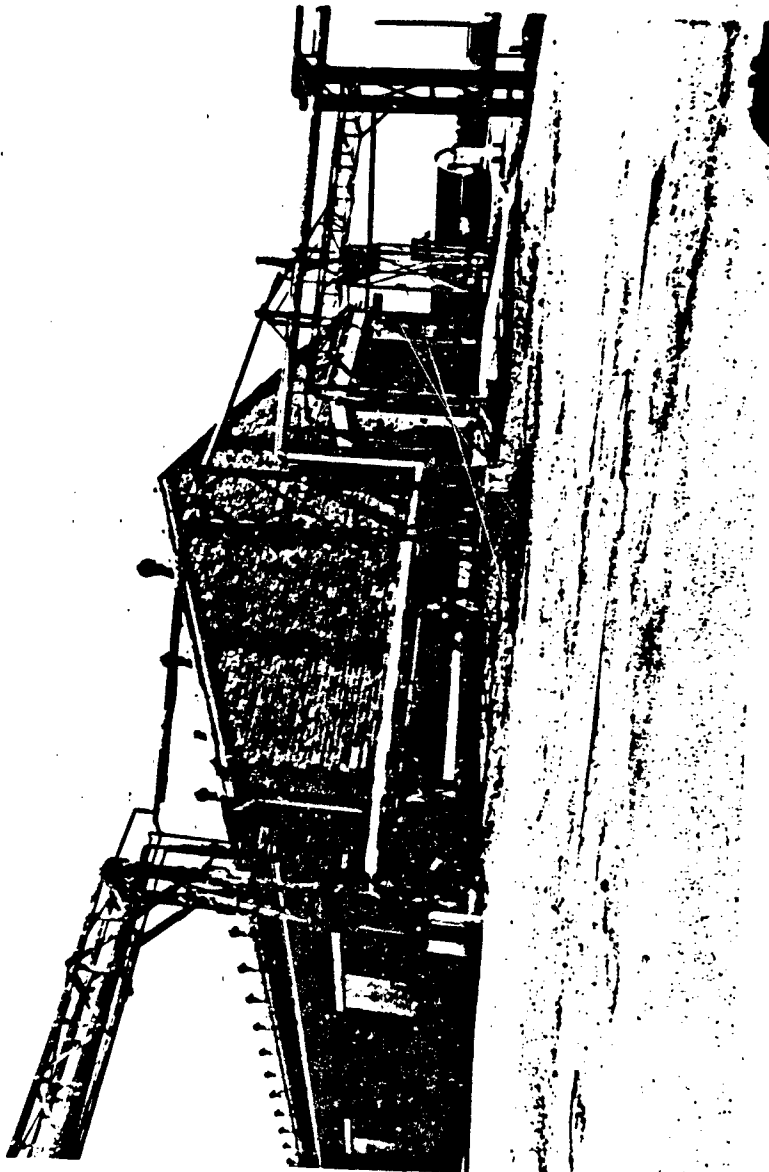


Figure 10: Building 742, formerly a napalm bomb filling plant, is currently a warehouse (Source: Field inventory photograph, 1983, Jeffrey A. Hess MacDonald and Mack Partnership).



Figure 11: Originally designed as an incendiary bomb facility, Building 732 was not completed until after V-J Day. It currently provides office space for the Army Reserve (Source: Field inventory photograph, 1983, Jeffrey A. Hess, MacDonald and Mack Partnership).

Technology

By the end of World War II, RMA had experienced so many technological changes that, with the exception of the chlorine plant, the installation "was in one hundred percent production of items other than those for which it was originally designed."⁷ Such widespread modification did not stem from any defect in planning. Rather, it resulted from the unpredictable nature of the war. When the Roosevelt Administration authorized the production of toxic gases during World War II, it was with the understanding that the United States "shall under no circumstances resort to the use of such weapons unless they are first used by our enemies."⁸ In preparation for retaliatory strikes, the War Department stockpiled gas-filled munitions in all theaters of combat, but neither provocation nor retaliation ever occurred. Since gas-filled munitions were never expended, their supply quotas were quickly filled, resulting in manufacturing cutbacks at the chemical-warfare arsenals. At RMA, the mustard-manufacturing plant was deactivated and placed in standby condition as early as May 1943. The lewisite operation was shut down six months later and subsequently dismantled.

Both gas-manufacturing operations, along with the production processes for the various intermediate chemicals, employed standard industrial technologies. Mustard gas was made by the well-established Levinstein process, involving the reaction of ethylene gas and sulfur monochloride, with chlorine gas and caustic solution used for "neutralization and decontamination of spills, wild batches, and equipment." Lewisite was manufactured by a more recently developed English process that had been

refined at Edgewood Arsenal. The procedure called for "the reaction between arsenic trichloride and gaseous acetylene in the presence of an aqueous hydrochloric acid solution of mercuric chloride [with] thionyl chloride . . . used for the completion of the reaction."⁹ None of the arsenal's original production equipment for any of the chemical operations survives at the installation.

The suspension of war-gas production caused only a temporary lull at RMA. Almost immediately the Chemical Warfare Service began converting idle buildings to the manufacture of aerial incendiary munitions, which were in short supply in both Europe and the South Pacific. Between November 1943 and April 1945, several former warehouses (Buildings 451, 538, 541, 542) and chemical facilities (Buildings 522, 522A, 523, 523A, 523B) were adapted for the production of white-phosphorous cups and igniters, which formed part of the ignition train in incendiary bombs. Other buildings (Buildings 333, 341-346) were remodeled for napalm-loading and assembling of 10-pound bombs into 500-pound clusters. These activities augmented the RMA's original incendiary-munitions lines (Buildings 741, 742), which produced 100-pound napalm bombs.¹⁰ Immediately following V-J Day, all incendiary manufacturing ceased, and RMA became a standby installation.

KOREAN WAR

After the surrender of Japan, the federal government leased many of the RMA's former war-gas production buildings to private industry, with the understanding that all facilities would revert to military control in the event of a national emergency. The principal lessee was Julius Hyman

and Company of Chicago, which used its new arsenal-based plant for the manufacture of insecticides and synthetic resins. In 1952 this operation was taken over by Shell Chemical Company, which had purchased the Chicago firm the previous year. Shell's leasehold at RMA has continued to the present time.¹¹

RMA remained a standby installation until 1950, when the arsenal's incendiary-munitions lines were reactivated for the Korean War (Figure 12). At the same time, the government announced a \$30 million construction program in the north-central section of the arsenal "for the manufacture of a top secret incendiary." Under the general supervision of the North Atlantic Division Engineers, Vitro Corporation served as architect, and Utah Construction Company as builder. After the project was completed in 1953, military officials revealed that the new facilities actually were for the production and loading of a highly toxic nerve agent originally developed by German scientists during World War II. The new substance was an organic phosphate compound, known as both Sarin and GB.¹² The RMA operation was designed to manufacture GB (Building 1501), load the nerve agent into projectiles, warheads, and bomblets (Building 1601), and assemble loaded bomblets into larger, cluster bombs (Building 1606) (Figure 13). Although nerve-agent loading operations continued throughout the 1960s (Figure 14), the GB Production Building (Building 1501) was shut down and placed in standby condition in 1957. Most of the nerve-agent manufacturing and loading machinery has been dismantled and removed from the arsenal.¹³



Figure 12: These arsenal employees who strapped together an incendiary-bomb cluster during the Korean War used the same labor-intensive assembly techniques as their World War II counterparts (Source: Denver Post, September 19, 1952).



Figure 13: The production facility for nerve agent GB (Building 1501) is a seven-story reinforced-concrete structure currently in standby condition (Source: RMA Administrative Archives, c. 1980).

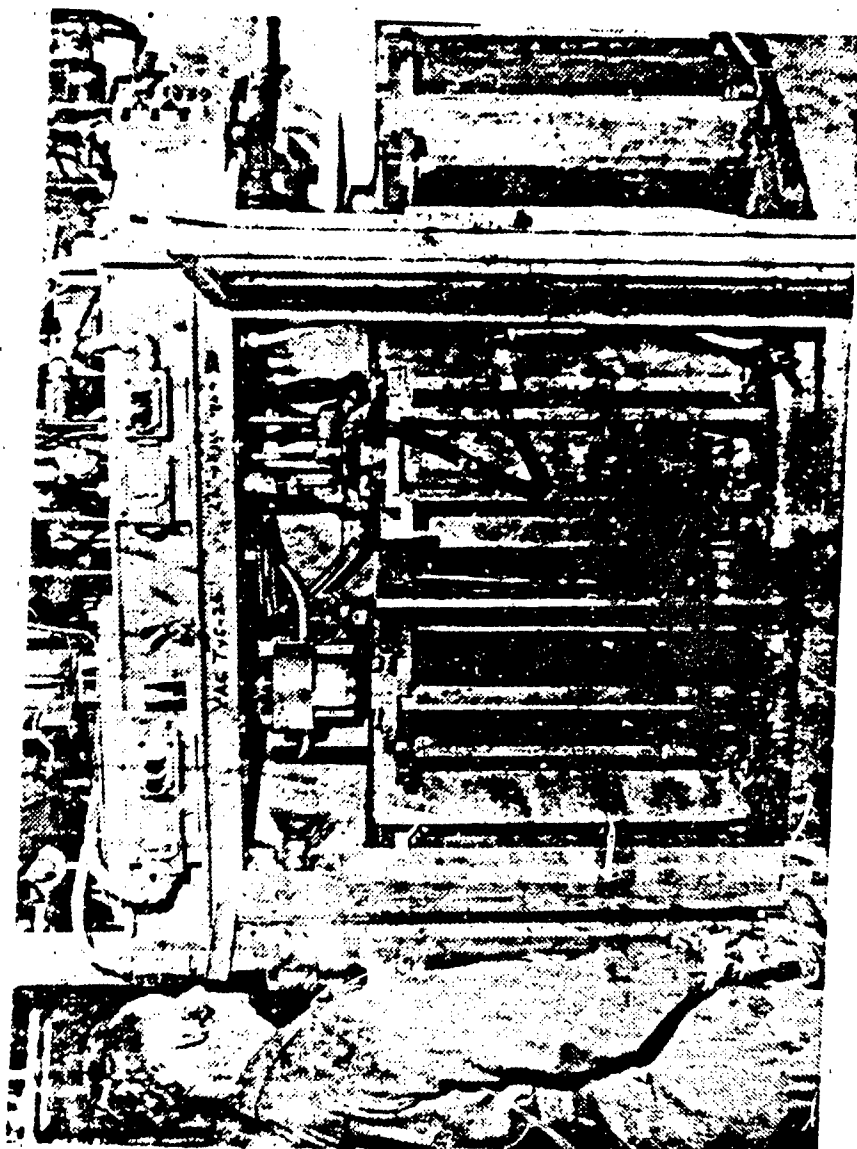


Figure 14: Automatic filling machine in Building 1601 loads nerve agent into rocket warhead in 1963 (Source: Denver Post, June 25, 1963).

VIETNAM WAR TO THE PRESENT

After the resolution of the Korean War, RMA served as a research-and-development facility for chemical agents and munitions. Arsenal personnel, for example, developed improved methods for chemical-shell filling and engineered a facility for blending rocket fuels (Building 756). Although the arsenal reactivated its manufacturing lines for smoke and incendiary devices during the Vietnam War, the installation increasingly devoted its technological resources to the destruction rather than the production of chemical munitions.¹⁴ In 1968 the Army decided that all excess and obsolete chemical stocks stored at RMA should be "demilitarized," or disposed of, by dumping at sea. This plan, called "Operation Chase," was scheduled to begin in April 1969, but public concern over safety and environmental issues led to its cancellation. In an attempt to find socially and environmentally acceptable alternatives, the Army submitted the problem to the National Academy of Sciences (NAS), which recommended the development of remote-control demilitarization techniques to "[minimize] the risk to all operating personnel as well as [to] the citizens of the surrounding communities."¹⁵

To comply with NAS recommendations, the Army designed and installed an innovative, nerve-gas detoxification system in the former GB Case-Filling Building (Building 1606). Demilitarization of GB cluster bombs began in the fall of 1973, and during the next three years approximately four million pounds of nerve agent were destroyed, representing "the largest

single [demilitarization] undertaking in the history of the Army."¹⁶ At the start of the operation, the local press provided the following description:

The detoxification is done by remote control utilizing closed circuit television. The \$33 million building in which the detoxification is conducted is under negative air pressure. That is air can enter the building, but no air can be released — even if there's an explosion — without passing through an elaborate scrubber system and an equally elaborate monitoring and alarm system that will shut the process down in the event of a malfunction. The detoxification system neutralizes the nerve gas with a caustic solution. Explosives in the bombs are burned away in a specially built furnace. The neutralized nerve gas agent is dried, and the solid residue is packed into 55-gallon drums for storage at the arsenal. The metal in the bombs also is neutralized and reduced to scrap.¹⁷

While the cluster-bomb disposal program was in progress, the Army installed in Building 1606 a still more sophisticated detoxification center for the GB-filled Honest John Rocket and Weteye Bomb. Employing a completely computerized monitoring system and updated scrubbing towers, the system became operational for GB munitions in the spring of 1976. It has subsequently been used for disposing of a variety of obsolete toxic agents (Figure 15)¹⁸.



Figure 15: In Building 1606 operators tend computer console that monitors dismantling and disposal of toxic munitions (Source: RMA Administrative Archives, c. 1977).

NOTES

1. The standard study of American use of chemical munitions during World War II is Brooks E. Kleber and Dale Birdsell, The Chemical Warfare Service: Chemicals in Combat (Washington, D.C.: Office of the Chief of Military History, United States Army, 1966). On the role of Edgewood Arsenal and on the authorization of the three new installations, see Leo P. Brophy and George J. B. Fisher, The Chemical Warfare Service: Organizing for War (Washington, D.C.: Office of the Chief of Military History, Department of the Army, 1959), pp. 10-13, 31-32, 36-37, 120-122.
2. Armed Service Forces, Chemical Warfare Service, "History of Rocky Mountain Arsenal," vol. 1, p. 4, unpublished report, 1945, RMA Administrative Archives.
3. "Army Chemical Plant Is Building in Denver," Denver Post, December 12, 1942. After World War II, approximately 2,500 acres of arsenal land were acquired by Stapleton International Airport, which borders the installation on the south. RMA's present size is 17,238 acres.
4. See section on "Engineering and Construction Contracts," in "History of Rocky Mountain Arsenal," Vol. 5, pp. 1270-1278. C. J. Kerahaw Construction Company of Birmingham formed a joint venture with Swinerton and Walberg of San Francisco to build RMA. The contractors, as well as the architects, were assisted by H. A. Kuljian and Company of Philadelphia. Whitman, Requart and Smith designed all of the industrial structures, except for the chlorine plant and the thionyl chloride plant, which were the work of H. K. Ferguson Company of Cleveland. E. I du Pont de Nemours & Co. served as design consultant for Whitman, Requart and Smith; Hooker Electro-Chemical Company played a similar role for H. K. Ferguson Company.
5. On the unique layout of RMA, see "History of Rocky Mountain Arsenal," vol. 2, pp. 431-432.
6. See "History of Rocky Mountain Arsenal," vol. 1, pp. 46-55; vol. 2, p. 578; vol. 4, pp. 1124-1127; vol. 5, pp. 1275-1277; vol 9, p. 2965.
7. "History of Rocky Mountain Arsenal," vol. 1, p. 20.
8. Roosevelt's statement on gas warfare is quoted in Brophy and Fisher, p. 88. The stockpiling of gas munitions in combat areas is discussed in Kleber and Birdsell, pp. 36-276.
9. "History of Rocky Mountain Arsenal," vol. 8, pp. 2510, 2592.
10. The various incendiary-manufacturing operations are described in "History of Rocky Mountain Arsenal," vol. 2, pp. 437-457, 473-476; vol. 3, pp. 879-884, 905; vol. 4, pp. 1074-1101, 112-1130, 1164-1170.

11. On leasehold arrangements, see Denver Post, January 13, 1947, November 29, 1951, March 20, 1964; "History of Rocky Mountain Arsenal," unpublished report, 1980, p. 3.
12. On the construction of the GB plant, see Cal Queal, "The Many Secrets of Rocky Mountain Arsenal," Denver Post--Empire Magazine, April 13, 1969, 11; also, "History of Installation/Activity," unpublished report, c. 1980, p. 1, RMA Administrative Archives. Historical background on the development of GB is found in "Nerve Gases Unveiled," Chemical and Engineering News, 31 (November 9, 1953), 4676-4677.
13. Author's interview with Dr. William McNeill, RMA Director of Technical Operations, September 1983. Inventories of surviving GB production equipment are listed under appropriate building number in "Rocky Mountain Arsenal Real Property Inventory," 7 vols., unpublished report prepared by Harland Bartholomew & Associates and Gilbert/Commonwealth, 1982-1983, RMA Facilities Engineer's Office Archives.
14. "History of Rocky Mountain Arsenal," 1980, p. 5.
15. "History of Rocky Mountain Arsenal," 1980, p. 6.
16. "History of Rocky Mountain Arsenal," 1980, p. 7.
17. Tom Rees, "Nerve Gas Detoxification Begins at Arsenal," Rocky Mountain News, October 30, 1973.
18. "History of Rocky Mountain Arsenal," 1980, p. 9; "Rocky Mountain Arsenal Chemical Demilitarization Facilities and Equipment," unpublished report, c. 1980, RMA Administrative Archives.

Chapter 3

PRESERVATION RECOMMENDATIONS

BACKGROUND

Army Regulation 420-40 requires that an historic preservation plan be developed as an integral part of each installation's planning and long-range maintenance and development scheduling.¹ The purpose of such a program is to:

- Preserve historic properties to reflect the Army's role in history and its continuing concern for the protection of the nation's heritage.
- Implement historic preservation projects as an integral part of the installation's maintenance and construction programs.
- Find adaptive uses for historic properties in order to maintain them as actively used facilities on the installation.
- Eliminate damage or destruction due to improper maintenance, repair, or use that may alter or destroy the significant elements of any property.
- Enhance the most historically significant areas of the installation through appropriate landscaping and conservation.

To meet these overall preservation objectives, the general preservation recommendations set forth below have been developed:

Category I Historic Properties

All Category I historic properties not currently listed on or nominated to the National Register of Historic Places are assumed to be eligible for

nomination regardless of age. The following general preservation recommendations apply to these properties:

- a) Each Category I historic property should be treated as if it were on the National Register, whether listed or not. Properties not currently listed should be nominated. Category I historic properties should not be altered or demolished. All work on such properties shall be performed in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation (ACHP) as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800).
- b) An individual preservation plan should be developed and put into effect for each Category I historic property. This plan should delineate the appropriate restoration or preservation program to be carried out for the property. It should include a maintenance and repair schedule and estimated initial and annual costs. The preservation plan should be approved by the State Historic Preservation Officer and the Advisory Council in accordance with the above-referenced ACHP regulation. Until the historic preservation plan is put into effect, Category I historic properties should be maintained in accordance with the recommended approaches of the Secretary of Interior's Standards for Rehabilitation and

Revised Guidelines for Rehabilitating Historic Buildings² and
in consultation with the State Historic Preservation Officer.

- c) Each Category I historic property should be documented in accordance with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Documentation Level II, and the documentation submitted for inclusion in the HABS/HAER collections in the Library of Congress.³ When no adequate architectural drawings exist for a Category I historic property, it should be documented in accordance with Documentation Level I of these standards. In cases where standard measured drawings are unable to record significant features of a property or technological process, interpretive drawings also should be prepared.

Category II Historic Properties

All Category II historic properties not currently listed on or nominated to the National Register of Historic Places are assumed to be eligible for nomination regardless of age. The following general preservation recommendations apply to these properties:

- a) Each Category II historic property should be treated as if it were on the National Register, whether listed or not.
Properties not currently listed should be nominated.
Category II historic properties should not be altered or demolished. All work on such properties shall be performed

in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation (ACHP) as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800).

- b) An individual preservation plan should be developed and put into effect for each Category II historic property. This plan should delineate the appropriate preservation or rehabilitation program to be carried out for the property or for those parts of the property which contribute to its historical, architectural, or technological importance. It should include a maintenance and repair schedule and estimated initial and annual costs. The preservation plan should be approved by the State Historic Preservation Officer and the Advisory Council in accordance with the above-referenced ACHP regulations. Until the historic preservation plan is put into effect, Category II historic properties should be maintained in accordance with the recommended approaches in the Secretary of the Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings⁴ and in consultation with the State Historic Preservation Officer.
- c) Each Category II historic property should be documented in accordance with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Documentation Level

II, and the documentation submitted for inclusion in the HABS/HAER collections in the Library of Congress.⁵

Category III Historic Properties

The following preservation recommendations apply to Category III historic properties:

- a) Category III historic properties listed on or eligible for nomination to the National Register as part of a district or thematic group should be treated in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800). Such properties should not be demolished and their facades, or those parts of the property that contribute to the historical landscape, should be protected from major modifications. Preservation plans should be developed for groupings of Category III historic properties within a district or thematic group. The scope of these plans should be limited to those parts of each property that contribute to the district or group's importance. Until such plans are put into effect, these properties should be maintained in accordance with the recommended approaches in the Secretary of the Interior's Standards for Rehabilitation and Revised

Guidelines for Rehabilitating Historic Buildings⁶ and in consultation with the State Historic Preservation Officer.

- b) Category III historic properties not listed on or eligible for nomination to the National Register as part of a district or thematic group should receive routine maintenance. Such properties should not be demolished, and their facades, or those parts of the property that contribute to the historical landscape, should be protected from modification. If the properties are unoccupied, they should, as a minimum, be maintained in stable condition and prevented from deteriorating.

HABS/HAER Documentation Level IV has been completed for all Category III historic properties, and no additional documentation is required as long as they are not endangered. Category III historic properties that are endangered for operational or other reasons should be documented in accordance with HABS/HAER Documentation Level III, and submitted for inclusion in the HABS/HAER collections in the Library of Congress.⁷ Similar structures need only be documented once.

CATEGORY I HISTORIC PROPERTIES

There are no Category I historic properties at the RMA.

CATEGORY II HISTORIC PROPERTIES

There are no Category II historic properties at the RMA.

CATEGORY III HISTORIC PROPERTIES

There are no Category III historic properties at the RMA.

NOTES

1. Army Regulation 420-40, Historic Preservation (Headquarters, U.S. Army: Washington, D.C., 15 April 1984).
2. National Park Service, Secretary of Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings, 1983 (Washington, D.C.: Preservation Assistance Division, National Park Service, 1983).
3. National Park Service, "Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines," Federal Register, Part IV, 28 September 1983, pp. 44730-44734.
4. National Park Service, Secretary of the Interior's Standards.
5. National Park Service, "Archeology and Historic Preservation."
6. National Park Service, Secretary of the Interior's Standards.
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